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The Relationship Between Aerobic Endurance and Haemoglobin of Junior High School Football Players 26 Makassar

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ABSTRACT

This study aims to analyze the relationship between aerobic endurance and haemoglobin levels in soccer players at SMP Negeri 26 Makassar. This research uses quantitative methods with a correlational approach. The research sample consisted of 20 football players who were selected purposively. Aerobic endurance measurements are carried out using appropriate methods, while haemoglobin levels are measured using standard laboratory equipment. Data analysis was carried out using the Pearson correlation test. The results of the study showed that there was a significant relationship between aerobic endurance and haemoglobin levels in football players at SMP Negeri 26 Makassar with a correlation coefficient (R) of 0.308 and a significance value (p) of 0.000 ($p < 0.05$). There is a positive and significant relationship between aerobic endurance and haemoglobin levels. This shows that the better a player's aerobic endurance, the more optimal the haemoglobin levels in his body, which plays an important role in oxygen-carrying capacity and athletic performance.

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INTRODUCTION

Football is a sport that demands high physical performance, including optimal aerobic endurance. Aerobic endurance has an important role in supporting the working capacity of players during matches that last for long durations and varying intensities. According to (Bompa & Buzzichelli, 2019), aerobic endurance allows players to maintain the intensity of the game as well as accelerate recovery after high physical activity. Good

aerobic ability is closely related to the efficiency of the cardiovascular and circulatory systems in transporting oxygen to the working muscles.

One of the important indicators of aerobic capacity is the level of haemoglobin in the blood. Haemoglobin plays a role in the transport of oxygen from the lungs to all tissues of the body, including muscles that are active during exercise (Khadka, 2021). Optimal haemoglobin levels are needed in aerobic activity because oxygen is the main factor in the process of aerobic energy metabolism. Some studies have shown that athletes with high aerobic endurance tend to have better haemoglobin levels than less trained individuals (Santisteban et al., 2022)

Good aerobic endurance has to do not only with the body's ability to transport and use oxygen but also with the efficiency of energy metabolism in the muscles. According to (Barbosa et al., 2024), individuals with high aerobic endurance have a greater mitochondrial capacity to produce ATP aerobically, which is very important in endurance sports such as football. Therefore, understanding the factors that affect aerobic endurance, including haemoglobin levels, can help significantly improve athlete performance. In addition, recent research by (Tornero-Quiñones et al., 2020) showed that higher haemoglobin levels were associated with increased aerobic capacity and physical endurance in young athletes. This indicates that increasing haemoglobin can be one of the strategies in the development of training programs to improve the physical performance of football athletes. Therefore, it is important to understand how factors such as exercise patterns and nutrition can affect haemoglobin levels in the bodies of young athletes.

Aerobic endurance is one of the important components in athlete performance, especially in sports that require continuous physical activity such as football. Football is a sport that requires players to have optimal physical capacity, including good aerobic endurance to support the ability to play for 90 minutes of the match (Mubarok & Kharisma, 2021). Good aerobic endurance allows players to maintain a high intensity of play as well as reduce the risk of fatigue that can impact performance. Aerobic endurance is the body's ability to perform physical activity for a long time using an aerobic energy system, which is a system that uses oxygen in the process of energy metabolism. This ability is especially important in endurance sports such as long-distance running, cycling, and swimming.

Haemoglobin is a protein found in red blood cells that binds and transports oxygen from the lungs to the rest of the body. Regarding aerobic endurance, haemoglobin has the following roles: Oxygen Transport: Haemoglobin transports oxygen from the lungs to the working muscle tissue. Energy Metabolism Optimization (Rosove, 2024): Haemoglobin-carrying oxygen is used in aerobic metabolic processes to produce ATP, the main source of energy for muscles during endurance activity. Reduces Fatigue: The higher the haemoglobin level in the blood, the better the body's capacity to support aerobic activity and reduce the risk of fatigue.

Some of the factors that affect aerobic endurance and haemoglobin levels include:

1. Physical Exercise: Aerobic exercise such as running, swimming, and cycling can increase blood volume and haemoglobin production.
2. Nutrition: Iron intake, vitamin B12, and folic acid play an important role in haemoglobin production.
3. Genetics: Hereditary factors also affect a person's haemoglobin levels.
4. Altitude: Exercising in high-altitude areas can stimulate the body to increase haemoglobin production to compensate for low oxygen levels in the air.

One of the factors that affects aerobic endurance is the level of haemoglobin in the blood. Haemoglobin has a major role in the transport of oxygen throughout the body, including to the muscles that work during physical activity. Optimal haemoglobin levels will increase the body's ability to supply oxygen so that it can support better aerobic performance. In contrast, low haemoglobin levels can lead to fatigue faster due to a lack of oxygen available for aerobic metabolism.

At the junior high school level, the physical and physiological development of students who are active in sports is an important aspect that needs to be considered. SMP Negeri 26 Makassar football players, as young athletes who are undergoing physical development, need to pay attention to the condition of their aerobic endurance and haemoglobin levels. Monitoring these two variables can provide an overview of the physical readiness of players as well as help in designing appropriate training programs to improve their performance on the field. Based on this background, this study aims to analyze the relationship between aerobic endurance and haemoglobin levels in football players of SMP Negeri 26 Makassar. The results of this study are expected to provide useful information for coaches, sports teachers, and related parties in developing more effective training strategies to increase players' endurance to the maximum.

METHODS

This study uses a quantitative method with a correlational approach to analyze the relationship between aerobic endurance and haemoglobin levels in football players of SMP Negeri 26 Makassar.

The population in this study is all football players at SMP Negeri 26 Makassar. The research sample was taken from as many as 20 people with a purposive sampling technique, where subjects were selected based on certain criteria, namely having varying fitness levels and participating in a regular football training program.

Research Instruments

Haemoglobin Test: Haemoglobin level measurement is carried out using a digital Haemoglobin Meter device which is taken through a capillary blood sample from a fingertip. This process is carried out by competent medical personnel to ensure the accuracy of the results.

Aerobic Endurance Test: To measure aerobic endurance, the Multi-Stage Fitness Test (Beep Test) running test is used. The test was conducted in the field following a

standard procedure, where participants ran back and forth for 20 meters according to an increasing cadence.

Research Procedure

1. The research subject is provided with information related to the research objectives and procedures and gives consent to participate.
2. Haemoglobin level measurements are performed before the aerobic endurance test to ensure there is no effect of fatigue on the test results.
3. An aerobic endurance test is carried out after a 10-minute warm-up to avoid injury.
4. The data obtained were analyzed using the Pearson correlation test to determine the relationship between haemoglobin levels and aerobic endurance.

The data obtained was statistically analyzed using SPSS software to see the relationship between the two variables. A normality test is performed before the correlation test to ensure that the data meets the assumptions of parametric statistics. The results of the analysis will be presented in the form of tables and descriptive interpretations to provide a clearer picture of the relationship between aerobic endurance and haemoglobin levels in young football players.

RESULTS AND DISCUSSION

Result

The descriptive analysis (overview) of the research data consisting of aerobic endurance test scores with haemoglobin of SMP Negeri 26 Makassar football players can be seen in the summary of the results of the descriptive analysis listed in the following Table 1.

Table 1.
Summary of the results of the descriptive analysis of test data aerobic endurance with haemoglobin of football players of SMP Negeri 26 Makassar.

Value	N	Total	Average	Range	Min	Max
DTA	20	576.50	28.8250	5.00	26.80	31.80
HB	20	262.10	13.1050	6.70	10.30	17.00

Information:
DTA: Aerobic endurance
HB : Haemoglobin

Table 1 above is an overview of aerobic endurance data with haemoglobin of SMP Negeri 26 Makassar football players can be presented as follows:

1. Aerobic endurance, obtained a total value of 576.50, an average of 28.8250, a minimum data of 26.80, a maximum data of 31.80, and a value range of 5.00.
2. Haemoglobin, obtained a total value of 262.10, an average of 13.1050, a minimum data of 10.30, a maximum data of 17.00, and a value range of 6.70.

The results of the descriptive analysis mentioned above are only an overview of the data on aerobic endurance with haemoglobin of football players of SMP Negeri 26 Makassar. The data mentioned above has not described how the relationship or interrelationship between the variables of this study is. To prove whether there is a

significant relationship between the independent variable, namely aerobic endurance (X1), and the bound variable, namely haemoglobin (Y), further testing is needed, namely by testing the normality of the data.

Research data to be analyzed statistically must meet the requirements for analysis. For this reason, after the data on aerobic endurance with haemoglobin of SMP Negeri 26 Makassar football players in this study were collected, before conducting statistical analysis for hypothesis testing, a requirement test was first carried out, namely normality (Kolmogorov-Smirnov Z).

From the results of the normality test (Kolmogorov-Smirnov Z) carried out, the results were obtained as attached. The calculation results can be seen in the summary of Table 2 next:

Table 2.
Summary of data normality test results aerobic endurance with haemoglobin of football players of SMP Negeri 26 Makassar.

Variable	N	Absolute	Positive	Negative	KS-Z	As.Sig	Information
DTA	20	0.299	0.229	-0.105	1.022	0.247	Normal
HB	20	0.158	0.158	-0.073	0.704	0.704	Normal

Table 2 above shows the results of the data normality test using the Kolmogorov-Smirnov shows the following results:

1. Aerobic endurance is obtained by the value of Asymp. Sig 0.247 (P>0.05), then it can be said that the aerobic endurance data follows the normal distribution or is normally distributed.
2. Haemoglobin obtained the value of Asymp. Sig 0.704 (P>0.05), then it can be said that the Haemoglobin data follows the normal distribution or is normally distributed.

For the hypothesis test, a correlation test was carried out between aerobic endurance data and haemoglobin of SMP Negeri 26 Makassar football players using correlation techniques and the Pearson product-moment. The results of the correlation analysis will be explained as follows:

Table 3.
Summary of the results of the analysis of the correlation between aerobic endurance and haemoglobin of football players of SMP Negeri 26 Makassar.

Variable	R	p	Information
DTA(X1) – HB (Y)	0.308	0.000	Significance

Based on Table 3 above, it can be seen that the results of the correlation calculation *Pearson*, obtained the calculation correlation value (r) = 0.308 (P < 0.05), meaning there is a significant relationship between aerobic endurance with haemoglobin of football players of SMP Negeri 26 Makassar.

Discussion

This research indicates a correlation between aerobic endurance and haemoglobin levels among junior high school soccer players at SMP Negeri 26 Makassar. Based on

correlational analysis, it was found that higher haemoglobin levels positively correlate with better aerobic endurance. (Rosove, 2024), which states that optimal haemoglobin levels support improved aerobic capacity in athletes. An increase in haemoglobin levels can contribute to enhanced oxygen transport to muscles during physical activity, ultimately improving aerobic endurance performance. This finding supports the theory (Khadka, 2021), which explains that haemoglobin plays a central role in the oxygen transport system and aerobic energy production.

The results of the analysis of the relationship between the two independent variables to the bound variables in hypothesis testing need to be further studied by providing an interpretation of the relationship between the results of the analysis achieved and the theories underlying this research. This explanation is needed so that the compatibility of the theories presented with the results of the research obtained can be known. The explanation to provide clarity on the relationship of independent variables to bound variables is as follows: The results of the first hypothesis test: there is a significant relationship between aerobic endurance and haemoglobin of SMP Negeri 26 Makassar football players. The statistical results showed that there was a significant relationship between aerobic endurance and haemoglobin of SMP Negeri 26 Makassar football players. If the results of the research are associated with the underlying theory and framework of thinking, then basically the results of this research support and strengthen the existing theories and results of previous research.

Additionally, training and nutrition factors also play a significant role in improving aerobic endurance and haemoglobin levels. According to Thomas, Erdman, and Burke (2016), structured endurance training programs and the consumption of iron-rich and vitamin B12-rich foods can help increase haemoglobin levels in the blood (Illahi et al., 2024). Therefore, the results of this study imply that a combination of appropriate physical training and proper nutrition can enhance the performance of young athletes. Furthermore, this study also shows that individuals with low haemoglobin levels tend to experience fatigue more quickly compared to those with optimal haemoglobin levels. This finding is relevant to research conducted by (Rosove, 2024), which revealed that low haemoglobin levels can limit aerobic capacity and delay muscle recovery after physical activity.

Thus, this research underscores the importance of monitoring haemoglobin levels in the development of young athletes, particularly in endurance sports like soccer. Coaches and medical personnel need to collaborate to ensure that athletes maintain adequate haemoglobin levels and follow appropriate training programs to enhance their aerobic endurance. The findings of this study are expected to serve as a foundation for developing scientifically-based training programs to improve the performance of young soccer players.

CONCLUSION

The results of the study showed that there was a significant relationship between aerobic endurance and haemoglobin levels in football players at SMP Negeri 26 Makassar

with a correlation coefficient (R) of 0.308 and a significance value (p) of 0.000 ($p < 0.05$). Conclusion: There is a positive and significant relationship between aerobic endurance and haemoglobin levels. This shows that the better a player's aerobic endurance, the more optimal the haemoglobin levels in his body, which plays an important role in oxygen-carrying capacity and athletic performance.

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